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U.S. Budget Deficits and the Real Value of the Dollar

Michael M. Hutchison* and Adrian W. Throop**

As a direct result of U.S. fiscal expansion, the real value of the dollar has remained much stronger than can be explained solely by differentials between real interest rates in the U.S. and those abroad. Forecasts of the dollar's value based on a longer run, general equilibrium model have much smaller errors than those from a short-run, partial equilibrium model relying on interest rate differentials alone. Thus, the real value of the dollar is likely to remain high by pre-1980 standards for the foreseeable future unless and until U.S. or foreign countries change their fiscal policies.

By the summer of 1985, the real trade-weighted value of the dollar stood at nearly 35 percent above its 1980 value (see Chart 1). In September, the United States together with West Germany, Japan, the United Kingdom and France announced that they were prepared to undertake coordinated intervention in currency markets to drive the dollar down and make it better reflect fundamental economic conditions. However, there is considerable disagreement among policymakers, academics, and market participants alike over the fundamental forces causing the phenomenal strength of the dollar. Moreover, a strong argument can be made that the dollar is not fundamentally overvalued.

Among the factors most often cited for generating a strong dollar are the present stance and future outlook of U.S. budget policy. According to this view, the exchange value of the dollar has closely followed the course of U.S. budget policy relative to budget policies abroad.

Casual evidence seems to support this linkage as Chart 2 indicates. Measured on a cyclically adjusted basis, the U.S. general government fiscal balance has fallen from a fairly large surplus position in 1980 (0.7 percent of potential GNP) to a large deficit position (1.9 percent of potential GNP) in 1985. Moreover, the generally expansionary fiscal policy in the U.S. has not been matched, and in fact has been counteracted, by restrictive fiscal policies followed by most other major nations in recent years. West Germany, for example, reversed a 2.4 percent budget deficit (cyclically adjusted) in 1980 into a 1.1 percent surplus in 1985. Similarly, Japan's large 4.0 percent deficit in 1980 was cut to 1.0 percent by 1985.

However, even among the group of economists that are convinced of strong causal links between fiscal policy and real exchange rates, there is considerable controversy. At least two views may be distinguished. One view, expressed for example by former Chairman of the Council of Economic Advisers Martin Feldstein (see Box), states that the influence of the recent U.S. fiscal stimulus on the dollar works primarily through interest rate differentials and portfolio adjustments. High and rising U.S. real interest rates associated with domestic

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U.S. Fiscal Policy and the Real Value of the Dollar: Two Views

"The sharp increase in the dollar has occurred because dollar securities and dollar bank deposits have become much more attractive in comparison to investments in other currencies. The principal reason for this increased attractiveness has been the sharp rise in the real interest rate on medium-term and long-term investments relative to the return available elsewhere. . . The sharp rise in real interest rates since the beginning of the decade is due primarily to the dramatic increase in the level of current and future structural budget deficits. . .

Although a sharp reduction in real interest rates and projected budget deficits would bring an immediate decline of the dollar, we can say with confidence that the dollar must eventually fall even if budget deficits are not reduced. At some point, possibly as long as several years from now, foreign investors will become reluctant to continue putting a larger and larger share of their portfolios in dollar securities because the increasing risk of an unbalanced portfolio will outweigh the yield advantage of dollar securities. When that occurs, the dollar will fall."

Martin Feldstein (*The United States in a Global Economy:* Hearing before the Committee on Foreign Relations, United States Senate, February 28, 1985, pp. 116–118)

"The model for the real interest rate does well in explaining that a rise in U.S. interest rates should lead to an appreciation of the real exchange rate. But it fails when it predicts that the real exchange rate should also be depreciating. That has not in fact been happening, and a theory is needed that will explain why the dollar—real or nominal—is both high *and* stuck. I believe fiscal policy may provide an answer."

"The fiscal interpretation of exchange rate movements does not suggest that U.S. fiscal expansion leads to higher U.S. real rates and lower real rates abroad. The world capital market is integrated and securities are highly substitutable. Therefore, except for transitory anticipated real exchange rate movements, the real rate of interest is internationally approximately equal. Fiscal expansion in the world, given tight money, will raise the *world* real rate of interest in response to the current and anticipated stimulus to demand. In addition the currency of the country that is relatively more expansionary will appreciate."

Rudiger Dornbusch (*Brookings Papers on Economic Activity,* 1: 1983; p. 83; and *Foreign Exchange Value of the Dollar,* Joint Hearings Before the Subcommittee on International Trade, Investment, and Monetary Policy and the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance, and Urban Affairs, House of Representatives, Oct 5, 25, 27 and November 1 and 2, 1984, pp. 186–9) budget deficits, in this view, have created an interest rate differential that has attracted a foreign capital inflow. This inflow has, in turn, caused a temporary appreciation of the dollar exchange rate above its long-run equilibrium value.

The causality described represents a short run and partial equilibrium portfolio balance perspective. In that perspective, the real value of the dollar should gradually fall back to its former level, either because interest rates will eventually fall or because investors will become reluctant to invest an increasingly large share of their portfolios in dollar-denominated securities. A number of major published forecasts apparently have based their predictions of a gradually falling dollar on this type of reasoning. One problem with the simple portfolio balance view is that the dollar continued to strengthen after 1983 even though the real interest rate differential in favor of the U.S. diminished sharply, as shown in Chart 1.

An alternative view, expressed for example in the quotations from Dornbusch (see Box), does not necessarily question the short-run links between fiscal policy and exchange rates working through interest rate differentials and portfolio preferences. But, it stresses the long-run effects on goods markets and interest rates in a world of high capital mobility. This second link may be characterized as a goods market channel of transmission.

Basically, this longer run, general equilibrium view argues that the U.S. fiscal expansion has increased both the aggregate demand for goods worldwide and the relative demand for U.S. goods (because the fiscal expansion in the U.S. has led to relatively larger increases in spending on U.S. goods). Excess demand for goods in the U.S. and abroad causes an increase in the general level of world interest rates, while the relative excess demand for U.S. goods associated with the fiscal stimulus is eliminated by a real dollar exchange rate appreciation.

This view assumes that U.S. and foreign goods are imperfect substitutes, and that their relative price (the real exchange rate) will change over time in response to shifts in fiscal policy. No expectation of a subsequent fall in the value of the dollar back to its original level is therefore required. Moreover, a high degree of substitutability between U.S. and foreign financial assets limits the extent to which U.S. real interest rates can diverge from foreign real interest rates in the long-run.

This paper develops a simple theoretical model that incorporates both the short-run, partial equilibrium portfolio balance and the longer run general equilibrium views of the way exchange rates are influenced by a fiscal stimulus. The portfolio balance view is presented in Section I, and the general equilibrium view is explained more fully in Section II. The methodology employed for empirical implementation of the completed model is presented in Section III. Empirical tests are performed in Section IV to estimate the relative importance of the various factors in influencing the trade-weighted real value of the dollar over the 1974–1985 floating rate period. The out-of-sample forecasting performance of the two models, as well as the performance of a simple random walk forecast are examined. The final section draws some conclusions for policy.

I. Interest Rate, Risk and the Exchange Rate: Portfolio Balance View

To show the linkages between the real exchange rate and real interest rate, we used an approach that is basically a simplification of Hooper and Morton's (1982) extension of the sticky-price monetary model of exchange rate determination developed by Dornbusch (1976) and Frankel (1979). The exchange rate equation in this framework may be derived initially from the uncovered interest parity condition. This is an arbitrage condition that states that the expected percentage change in the exchange rate over any period is equal to the difference between the nominal returns on securities at home and equally risky securities abroad, with maturities for that same period:

$$\ln s - \ln s^e = n(i - i^*) \quad (1)$$

where i = U.S. interest rate on security with n years to maturity;
i^* = foreign interest rate on a similar security;
s = foreign currency price of the dollar;
s^e = foreign currency price of the dollar expected to prevail n periods in the future.

Equation 1 holds when financial capital is freely mobile across national boundaries and investors are willing to accept equivalent yields on U.S. and foreign securities regardless of the currency of denomination. In this case, any deviation from uncovered interest parity would cause investor arbitrage to bid the exchange rate back to that point where equation 1 would again hold.

Under circumstances where U.S. and foreign assets are less than perfect substitutes, however, equation 1 will not strictly hold as an equilibrium condition; and U.S. and foreign expected yields generally will differ. This case is represented by augmenting equation 1 with an expected equilibrium yield differential, or "risk premium", ϕ^e:

$$\ln s - \ln s^e = n(i - i^*) - n\phi^e \quad (2)$$

Rearranging gives:

$$\ln s = n(i - i^*) - n\phi^e + \ln s^e \quad (3)$$

Equation 2 is a condition that will hold in internationally integrated financial markets when investors behave rationally. It simply states that the market expectation of domestic currency depreciation over a given period will be equal to the difference in nominal returns between securities at home and those abroad over a similar holding period, less any expected yield differential. Portfolio balance models suggest that the expected yield differential (risk premium, ϕ^e) will depend on both investors' preferences and the relative supply of domestic and foreign securities. If investors view these securities as imperfect substitutes because of exchange rate risk or other factors, the expected yield differential would be positively associated with the supply of domestic debt relative to debt abroad.

It is convenient to think of the current spot exchange rate as linked to the future expected exchange rate through the interest differential. Equation 3 illustrates this relationship: A given risk-adjusted interest differential (that is, including ϕ^e) is consistent with any given spot exchange rate level, and only indicates the expected change in the (log) level of the exchange rate over the maturity of the bonds in question. Once expectations about the future spot rate are identified, however, the spot rate is determined. The link between the current price of a currency and its expected future price is hence quite strong, as it is in the case of any asset price.

Equation 3 also holds in real (or price-adjusted) terms.[1] Thus,

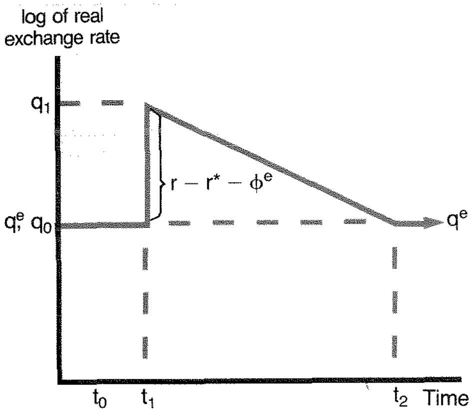
$$\ln q = n(r - r^*) - n\phi^e + \ln q^e \quad (4)$$

where q = real value of the dollar;
q^e = real value of the dollar expected n years hence;
r = U.S. real interest rate;
r^* = foreign real interest rate.

The difference between the current real exchange rate and its expected future value—that is, the expected change in the real value of the currency—is thus proportional to the expected (risk-adjusted) real interest rate differential, $r - r^* - \phi^e$. For example, a one-percent rise in the U.S. one-year real (risk-adjusted) interest rate above the equivalent foreign rate would appreciate the real value of the dollar by one percent above the spot value expected one year hence. This sets up the expectation of a one-percent dollar depreciation over the course of the year, which, in turn, equalizes expected risk-adjusted yields on the underlying foreign and domestic securities. Thus, the dynamics of exchange rate changes are implicit in the relative yield differential across currencies. This process is illustrated in Diagram 1. An important point to note, however, is that the effect

Diagram 1

Real Exchange Rate Response to Rise in the Domestic Real Intererst Rate Differential



The real exchange rate is price of the dollar in units of foreign currency (price adjusted). The risk adjusted real interest differential ($r - r^* - \phi^e$) rises at point t_1, causing an appreciation in the dollar exchange rate from q_0 to q_1). Over the maturity of the interest rate in question (from t_1 to t_2), the exchange rate gradually depreciates and causes a capital loss on domestic securities which exactly offsets the explicit additional interest rate return. At time t_2 the exchange rate returns to its original equilibrium value.

of interest rate variations on exchange rates is temporary. Over the maturity of the particular rate in question, the spot real exchange rate is expected to return to a fixed equilibrium value.

A central aspect of this theory is its emphasis on term structure effects. For example, if the 1-year U.S. real interest rate goes up by 1 percentage point, but future 1-year interest rates are not expected to change, then the real value of the dollar will go up only 1 percentage point. However, if the same increase in the U.S. 1-year rate is expected to last for 5 years, then the 5-year bond rate will immediately rise by 1 percentage point and the real exchange value of the dollar will rise by 5 percentage points. Thus, the long-term real interest differential controls movements in the real exchange rate.

The expected long-run real value of the exchange rate, or the relative value of a representative bundle of domestic goods in comparison to their foreign counterparts, is assumed to be roughly constant. Budget deficits, whether of a transitory or more permanent nature, do not alter the expected long-run real value of the dollar in this framework. The assumption of a fixed long-run relative price between domestic and foreign goods provides a convenient anchor on which expectations of the future real exchange rate can be based. Furthermore, the dynamics of exchange rate adjustment to interest rate shocks can also be derived from this assumption.

The real interest rate/real exchange rate link may be thought of as a portfolio balance channel through which budget deficits influence the real exchange rate. A rise in the U.S. budget deficit, to the extent that it causes U.S. real interest rates to rise above world levels, attracts a foreign capital inflow that temporarily appreciates the real value of the dollar, q, above its expected long-run equilibrium value, q^e. The dollar appreciates to the point where an expected future depreciation is set up that (in order to maintain internationally comparable yields on dollar and foreign investments) just offsets the extra interest rate return on dollar assets compared with foreign currency denominated assets. In other words, the dollar appreciates until an offsetting expected capital loss is created. In this view, the influence of budget deficits on exchange rates through the interest rate channel is transitory.

The pattern of initial exchange rate appreciation followed by gradual depreciation will occur in this framework regardless of whether budget deficits are perceived as temporary or longer lasting. In the former case, both interest rates and the exchange rate would rise and gradually fall back to their initial levels as financial market pressures associated with transitory budget imbalances subside. In the case of longer lasting budget deficits, however, interest rates would rise and stay above their initial values for as long as private aggregate demand is "crowded out" by the fiscal stimulus. This would not preclude a subsequent gradual exchange rate depreciation—as expressed in the quotation by Feldstein—if the expected return differential (ϕ^e) gradually rises over time in response to the accumulation of government debt associated with the longer lasting government deficit. In both cases—temporary or longer lasting budget deficits—the portfolio balance view predicts that the real exchange rate gradually depreciates and returns to its original level (q^e). However, both cases exemplify a partial equilibrium model because q^e is either assumed constant or determined outside the model.

II. Goods Markets, Interest Rates and the Exchange Rate: General Equilibrium View

The longer run, general equilibrium view of the budget deficit/real exchange rate link abstracts from the dynamics of expected changes in the exchange rate. The analysis is static and longer run so that expected and actual exchange rates do not differ. It focuses on the potential for budget policy to alter the real exchange rate in the long-run, and therefore to cause shifts in the expected equilibrium real exchange rate (q^e) that enters into the shorter run portfolio balance approach.

While the portfolio balance view allows for assets denominated in different currencies to be imperfect substitutes ($\phi^e \neq 0$), it in effect assumes that domestic and foreign goods are perfect substitutes, making their expected equilibrium relative price (q^e) constant. The general equilibrium model, in contrast, allows goods produced in different countries to be imperfect substitutes and allows their equilibrium relative price to change in response to shifts in the supply and demand for domestically produced versus foreign goods. The real exchange rate in this framework is a key factor helping to maintain a balance in domestic and foreign goods markets.

For example, a domestic fiscal stimulus—effected through either an increase in expenditures or a reduction in taxes—will increase the demand for both domestic and foreign goods, but is likely to raise the demand for domestic goods more. This relative rise in domestic demand, in turn, will put upward pressure on the domestic real interest rate relative to the foreign real interest rate. But since, in a world of high capital mobility, interest rates at home and abroad can differ by only a relatively small risk premium, the resulting inflow of capital will be sufficient to raise the domestic real exchange rate enough to offset most, if not all, of the effects of the fiscal stimulus. An appreciation of the real exchange rate accomplishes this both by lowering the private demand for domestically produced goods (exports and import-competing goods), and by raising that component of domestic demand directed towards imports.[2]

To put this argument in more formal terms, consider the equilibrium conditions for domestic and foreign goods markets, assuming a complete adjustment to full employment in both the U.S. and the rest of the world:

$$y = A(r) + NX(q) \tag{5}$$

$$y^* = A^*(r^*) + NX^*(q) \tag{6}$$

where y (y^*) = y_0 (y_0^*), fixed domestic (foreign) output

A (A^*) = domestic (foreign) absorption of goods and services, i.e. both home production and imports ($A = C + I + G$)

$NX(NX^*)$ = domestic (foreign) country net exports

$$\text{and } \frac{\partial A}{\partial r} < 0 \,;\ \frac{\partial A^*}{\partial r^*} < 0 \,;$$

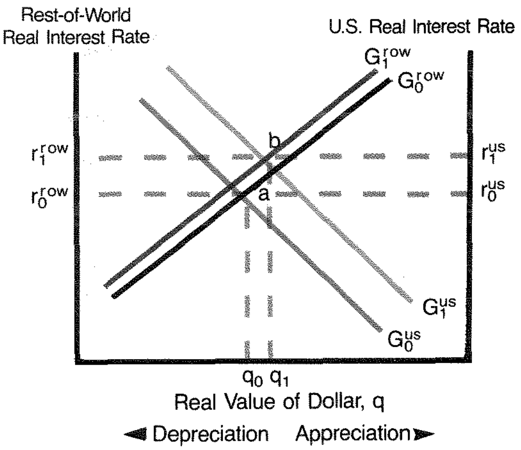
$$\frac{\partial NX}{\partial q} < 0 \,;\ \frac{\partial NX^*}{\partial q} > 0 \,;$$

We have three unknowns (r, r^*, and q) but only two equations. However, r can be solved as equal to r^* in the case where U.S. and foreign assets are perfect substitutes, or equal to $r^* + \phi$ in the risk premium case. This reduces the system to two equations and two unknowns.[3]

Diagram 2 provides a graphical representation of this system.[4] The downward sloping (q, r^{us}) locus, or G_0^{us}, is the U.S. (domestic country) goods market clearing condition, that represents equation 5. It is downward sloping because, for any given level of output, a fall in

Diagram 2

Effects of U.S. Fiscal Expansion when U.S. and Foreign Assets are Perfect Substitutes



q (depreciation of the real value of the dollar) stimulates net exports and must be offset by lower U.S. absorption brought about by an increase in the U.S. real interest rate. G_0^{row}, the rest-of-world (foreign) goods market equilibrium locus (q, r^{row}), is upward sloping for analogous reasons. In this case, however, a fall in q represents an appreciation of the foreign currency, and hence a contraction of rest-of-world net exports to the U.S. This is offset by a fall in rest-of-world interest rates and a corresponding rise in A^{row} (rest-of-world absorption) to maintain equilibrium in the rest-of-world goods market.

In the no risk premium case, the initial steady state equilibrium is found at the intersection of the goods market equilibrium schedules for the U.S. and the rest of the world, or point a, where $r_0^{us} = r_0^{row}$. Depending on the state of domestic aggregate demand and output relative to demand and output abroad, the U.S. has either positive or negative net exports.

Consider the comparative statics of a U.S. fiscal expansion. As U.S. fiscal expansion increases the demand for U.S. goods and services, domestic absorption (A^{us}) rises correspondingly. This shifts the U.S. goods market locus upward from G_0^{us} to G_1^{us} because, for any given real exchange rate, higher U.S. real interest rates are necessary to offset the rise in absorption and to restore equilibrium. Similarly, to the extent that the rise in U.S. government expenditures falls on foreign goods, the demand for rest-of-world net exports rises (at an unchanged real exchange rate) and G_0^{row} shifts upward to G_1^{row}. The rise in aggregate demand in both countries thus causes U.S. and rest-of-world interest rates to rise.

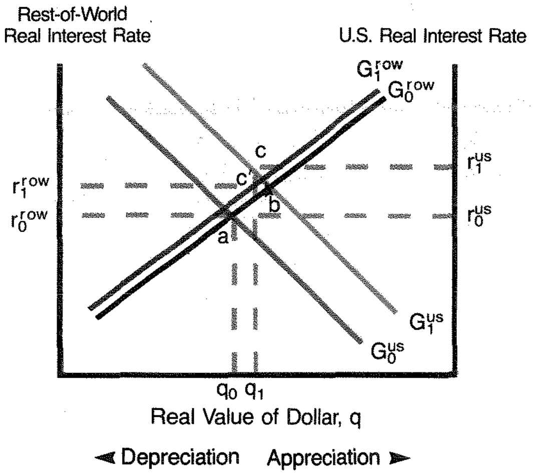
Most of the rise in aggregate demand falls on U.S. output, however. As long as U.S. and rest-of-world securities are perfect substitutes—which implies equal real rates of return in static equilibrium ($r_1^{us} = r_1^{row}$)—the incipient real interest differential in favor of the U.S. appreciates the dollar real exchange rate to divert private demand away from U.S.-produced goods towards foreign-produced goods. A general equilibrium is restored at point b, where the higher level of world interest rates dampens excess world aggregate demand (U.S. plus rest-of-world) pushed up by the U.S. fiscal stimulus, while dollar appreciation (from q_0 to q_1) dampens the relative excess demand for U.S.-produced goods.[5] Unlike the short-run portfolio balance model, the dollar appreciates without *any* increase in the equilibrium real interest rate differential.

The possibility of a risk premium ($\phi \neq 0$), or real yield differential, is easily incorporated into this framework. As noted earlier, a risk premium could arise if, over time, investors become reluctant to absorb an increasingly large share of U.S. debt into their portfolios. As shown in Diagram 3, a gradual rise in the risk premium (from an assumed initial value of zero) associated with cumulative U.S. budget deficits would allow a gap in the static equilibrium real interest differential.

In the case of a U.S. debt-financed fiscal stimulus, the U.S. real interest rate would rise above the rest-of-world interest rate ($r_1^{us} > r_1^{row}$), and the difference would be reflected in the gap between the G_1^{us} and G_1^{row} loci at an equilibrium real exchange rate to the left of point b (points c, c^1 for example). The result is that both the rest-of-world interest rate (r_1^{row})

Diagram 3

Effects of U.S. Fiscal Expansion when U.S. and Foreign Assets are Imperfect Substitutes



and the value of the U.S. dollar (q_1) rise less than in the no risk premium case. Once again, the result differs from the portfolio balance view in that, in the goods market view, the dollar normally appreciates following a fiscal stimulus in the U.S. even though there is no change in the *risk-adjusted* differential between real interest rates.

However, in the extreme case in which the risk premium grows so large that it leaves the real exchange rate and the rest of the world's interest rate unchanged, the end result is the same as that characterized by the portfolio balance view. That is, over the longer run the U.S. interest rate would rise enough to cause a fall in domestic interest-sensitive expenditures that entirely offsets the fiscal expansion's impact. The introductory quotation by Feldstein expresses this view of how the economy adjusts to ongoing fiscal deficits.[6]

III. Estimation Methodology

In the short-run, partial equilibrium portfolio balance approach, the real value of the exchange rate is expected to return to a constant expected long-run real value. In contrast, in the general equilibrium analysis, persistent budget deficits change the long-run equilibrium value of the real exchange rate. Because exchange market participants have a time horizon of at least several years, a combination of both approaches is required for explaining the actual behavior of exchange rates.

In a static long-run equilibrium, interest rates can diverge by only the amount of the risk premium. In the short-run, larger disparities in interest rates can temporarily occur, but they are counterbalanced by expected changes in the exchange rate. A useful synthesis of the two views therefore embeds a rational expectation of longer run equilibrium into the short-run dynamics of the portfolio balance approach.

In the general equilibrium model, the real exchange rate may depart from its original value even over extended periods of time. It can be altered by changes in tastes, technology, or supplies of productive factors. It can also be affected by imbalances between private saving and investment caused by budget deficits, or by changes in the risk premium. In our empirical estimation, we abstract from factors other than fiscal deficits that might cause changes in the equilibrium real exchange rate. Thus, the log of the real exchange rate expected in the future is assumed equal to some constant plus a function of the expected U.S. budget balance (B) and the rest of the world's budget balance (B*):

$$\ln q^e = a_0 - a_1 B^e + a_2 B^{*e} \qquad (7)$$

Substituting equation 7 into equation 4 yields the synthesis of the two views to be estimated:

$$\ln q = a_0 + n(r - r^*) - n\phi^e - a_1 B^e + a_2 B^{*e} \qquad (8)$$

To empirically estimate this model, we use Morgan Guaranty's real trade-weighted value of the dollar for q. We also calculated trade-weighted measures of real interest rates and expected budget balances. Because of data limitations, variables for the rest of the world were limited to the six largest OECD countries.[7]

As pointed out earlier, the real interest differential dominating movements in the real exchange rate is the long-term one. Rather than attempting to construct direct measures of long-term inflation expectations for each country, we used an indirect approach based upon the theory of the term structure of interest rates. Our model of the real long-term bond rate is based on the "preferred habitat" theory of the term structure of interest rates developed by Modigliani and others. This approach synthesizes the market segmentation and expectational theories of the term structure.

In this approach, the long-term interest rate is equal to the average of expected short-term rates, modified by a risk premium that reflects preferences of the two sides of the market for long versus short securities. In the original statement by Modigliani and Sutch (1966), the past history of nominal short-term rates is used to forecast expected future nominal rates. Therefore, the long-term bond rate is explained by the past history of short rates and a risk premium represented by a constant term. Analogously, in an inflationary world, one can model the real long-term bond rate as a function of the past history of real short-term rates (proxying for expected real short-term rates) plus a constant term to represent the risk premium.

For the real short-term interest rate in the U.S., we used the 6-month commercial paper rate. We forecasted inflation on the basis of past changes in M1 and past inflation.[8] Foreign interest rates are 90-day interbank rates, or the nearest equivalent. Expected inflation abroad was measured by the rate of change in consumer prices over the previous four quarters.[9] The empirical results are not particularly sensitive to various alternative measures of expected inflation.

In earlier work, it was found that the U.S. real bond rate can be satisfactorily explained by an 11-quarter distributed lag on the real short-term interest rate.[10] Consequently, we have modeled the real long-term interest rate differential, $r - r^*$, by an 11-quarter distributed lag on the difference between the real 6-month commercial paper rate and the trade-weighted value of real short-term interest rates abroad.[11] The estimated coefficient on this synthetic real long-term rate differential equals n, or the relevant time horizon of investors in the market, times the sum of the weights in the distributed lag on short rates. But since the latter should theoretically sum to a value close to one, the sum of these estimated coefficients should approximate n.

To measure anticipated budget surpluses or deficits (expected values of B and B*), a moving average of the actual high employment, or structural, budget balance for one year ahead was used. Structural budget balances are preferable to actual (non-cyclically adjusted) deficits because they better capture the goods market pressures associated with fiscal policy shifts. The one-year ahead measure was found to give more satisfactory results than a moving average over longer time horizons. Budget balances more than one year ahead cannot be known with any high degree of certainty because they can always be altered by policy changes. And even though the relevant time horizon of participants in the foreign exchange market is likely longer than one year, the structural budget balance for one-year ahead appears to be as good as any other indicator of the expected value of future structural budget balances.

We tried both inflation-adjusted and unadjusted structural budget balances, measured as a percent of potential GNP, in empirical estimates of the model. The inflation-adjusted measures treat the amount of the inflationary erosion in the real value of outstanding government debt as a receipt. Their appropriateness for this analysis depends upon the behavior of the private sector. To the extent that changes in real wealth affect household consumption, the inflation-adjusted indicator may be a more accurate gauge of fiscal impact on the economy than the unadjusted one. But if the inflation premium embedded in the interest rate were treated as disposable income, the nominal component of interest rates would affect consumption and the "inflation tax" would not. The unadjusted structural budget balance would then be the more appropriate one.[12]

The final variable requiring explanation is the expected risk premium, ϕ^e. This yield differential is determined by the interaction of demand and supply for assets in both the home and foreign countries. Following the large body of literature on the topic (e.g., Dornbusch, 1980; Frankel, 1982; Hutchison, 1984), we focus on the relative supplies and demands for government debt ("outside" assets). This approach assumes that exchange risk on privately issued "inside" assets is eliminated by portfolio diversification.[13]

An increase in the supply of domestic government debt, other things equal, causes a rise in the risk premium. In contrast, a rise in the proportion of domestic financial wealth in total world wealth, assuming domestic investors prefer the home country habitat, would cause a rise in the demand for domestic government debt and therefore lower the risk premium. The excess of domestic financial wealth over the domestic supply is represented by the cumulative domestic current account surplus. The domestic current account surplus represents the surplus of domestic national saving over private investment.

The risk premium can therefore be expressed as:

$$\phi^e = a_0 + a_1 \frac{D_s}{W_w} + a_2 \frac{\sum CA}{W_w} \qquad (9)$$

$$a_0 \lesseqgtr 0;\ a_1 > 0;\ a_2 < 0.$$

where D_s represents the supply of U.S. government debt, W_w represents the total supply of government debt (both foreign and domestic), and $\sum CA$ represents the cumulative U.S. current account surplus.[14]

IV. Empirical Results and Forecasts

Tables 1 and 2 present empirical estimates of three formulations of the real exchange rate model. The tables use structural budget balances adjusted for inflation and ordinary structural budget balances, respectively. As shown in Chart 2, the inflation-adjusted budget is always in larger surplus than the ordinary budget balance as long as inflation is positive because the adjustment for inflation treats the erosion in the real value of government debt as a tax. The inflation-adjustment can be relatively large—as much as 2 percent of GNP for the United States and somewhat larger for other major OECD countries. But the pattern of variation over time has been fairly similar for both budget concepts. In the United States, the largest difference between them occurs from 1978 to 1981 when inflation first rose quite sharply and then dropped even more abruptly. This caused the inflation-adjusted budget first to shift more sharply into surplus and then to fall more rapidly into deficit.

Columns 1–3 in both tables show estimates of three real exchange rate models for the 1974:Q3 through 1981:Q4 sample period, and columns 4–6 show estimates for the 1974:Q3 through 1984:Q3 full sample period. The shorter sample period was estimated to evaluate the stability of the estimated model coefficients and to perform out-of-sample forecasts that can be compared with actual movements in the dollar exchange rate. The shorter sample ends at the time when U.S. budget deficits were beginning to rise sharply relative to GNP and foreign deficits had begun to decline. Out-of-sample forecasts of recent experience therefore provide a useful test of the importance of U.S. and foreign budget balances, relative to the importance of real interest rate differentials, in affecting the real value of the dollar.

The three real exchange equations estimated represent the model containing only real interest differentials (columns 1 and 4), the model containing both real interest differentials and U.S. and foreign budget balances (columns 2 and 5), and the full model which includes real interest differentials, budget balances and the risk premium determinants (columns 3 and 6).

In Table 1, which contains the inflation-adjusted budgets, the estimates of the coefficients on the risk premium variables are statistically insignificant. However, lack of statistically significant risk premium variables is consistent with previous research (e.g., Frankel, 1982;

TABLE 1

Real Exchange Value of the Dollar: Regression Estimates With Inflation-Adjusted Structural Budget Surpluses[1]

	Sample: 1974:Q3 – 1981:Q4			Sample: 1974:Q3 – 1984:Q3		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.44	4.59	4.49	4.82	4.61	4.47
	(179.1)	(85.4)	(151.2)	(27.6)	(191.4)	(171.9)
$\sum_{i=0}^{11} (r_s - r_s^*)$	4.78	3.40	3.50	4.16	3.46	4.24
	(4.58)	(3.70)	(7.20)	(3.42)	(4.49)	(8.91)
B^e		−4.30	−4.11		−4.48	−2.83
		(−3.05)	(−7.00)		(−7.60)	(−5.44)
B^{*e}		2.96	1.94		3.22	1.00
		(2.11)	(2.29)		(3.12)	(1.13)
D^s/W_w			7.76			−2.87
			(0.55)			(−1.02)
$\sum CA/W_w$			−8.93			−0.02
			(−0.82)			(−0.01)
$\bar{R}^2$	.84	.88	.92	.95	.97	.98
SER	.019	.017	.013	.022	.018	.015
$\hat{\rho}$	.71	.59	−.21	.98	.62	.16
	(5.44)	(3.96)	(−1.19)	(33.4)	(5.03)	(1.02)
D.W.	1.68	2.00	2.22	1.65	1.84	1.88

[1] See text for definitions of variables and data sources. All equations were estimated using ordinary least squares and the Cochrane-Orcutt procedure to adjust for first-order serial correlation. The t-ratios are in parentheses.

TABLE 2

Real Exchange Value of the Dollar: Regression Estimates With Ordinary Structural Budget Surpluses[1]

	Sample: 1974:Q3 – 1981:Q4			Sample: 1974:Q3 – 1984:Q3		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.44	4.54	4.37	4.82	4.62	4.40
	(179.1)	(55.9)	(91.9)	(27.6)	(94.4)	(77.6)
$\sum_{i=0}^{11} (r_s - r_s^*)$	4.78	3.70	4.07	4.16	3.22	4.61
	(4.58)	(3.02)	(7.25)	(3.42)	(3.38)	(8.27)
B^e		−4.19	−4.28		−5.86	−3.35
		(−2.19)	(−4.49)		(−4.82)	(−4.42)
B^{*e}		1.90	−0.22		3.77	0.12
		(0.91)	(−0.14)		(2.49)	(0.07)
D^s/W_w			5.25			−3.09
			(0.33)			(−1.00)
$\sum CA/W_w$			−7.91			−0.63
			(−0.64)			(−0.24)
$\bar{R}^2$	.84	.86	.90	.95	.97	.97
SER	.019	.018	.016	.022	.018	.016
$\hat{\rho}$	.70	.72	−.03	.98	.73	.17
	(5.44)	(5.76)	(−0.19)	(33.9)	(6.86)	(1.13)
D.W.	1.69	2.00	2.01	1.65	1.91	1.93

[1] See Table 1 notes.

Danker, et.al., 1984; and others), indicating that risk premia on internationally traded assets are small, vary with time, and are difficult to associate systematically with structural variables.

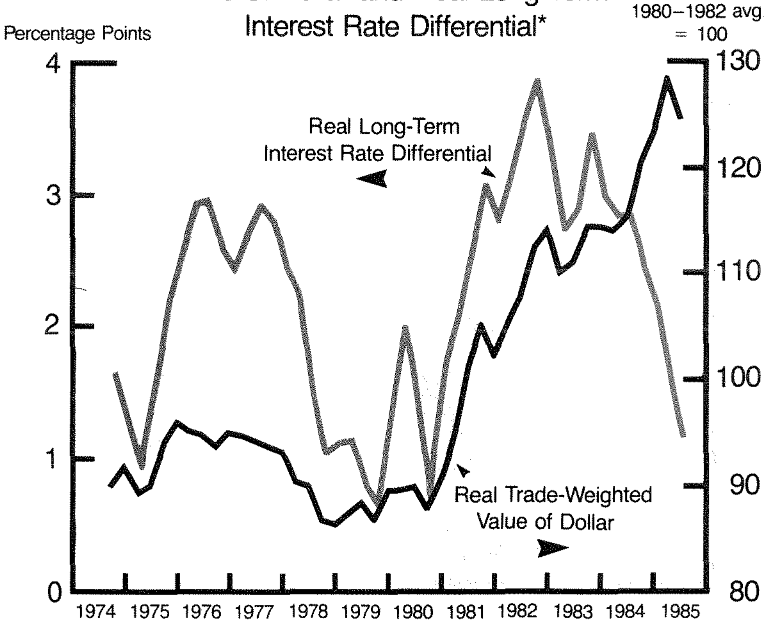
In contrast, the model estimates in Table 1 give statistically significant coefficients on the real interest differential ($r - r^*$), the expected U.S. structural budget balance (B^e), and the expected foreign structural budget balance (B^{*e}) of the theoretically predicted signs. Also, there is a high degree of stability between the estimates from the shorter and longer sample periods.

An increase of 1 percentage point in the real long-term interest rate differential in favor of the U.S. is estimated to have raised the real trade-weighted value of the U.S. dollar by 3.5 percent in the 1974:Q3—1984:Q3 sample period (column 5). This estimate is consistent with the view that investors in the market have a time horizon of roughly 3–4 years. A rise in the U.S. budget surplus by 1 percent of GNP is estimated to reduce the real trade-weighted value of the dollar by 4.5 percent. And a similar movement in the budget balances of our major trading partners is estimated to raise the real value of the dollar by 3.2 percent.

The estimates using ordinary structural budget balances (not inflation-adjusted) shown in Table 2 provide similar but somewhat less robust results. The estimated real interest differential and budget balance coefficients are again of the predicted signs and highly significant in the full sample, whereas the risk premium variables are statistically insignificant. The goodness of fit ($\bar{R}^2$), standard error, and other summary statistics are also very similar. However, the coefficient on the foreign budget balance is statistically insignificant in the shorter sample. Moreover, the coefficient estimates using ordinary budget balances are less stable across the two samples. Since these results suggest that the behavior of the private sector is affected, at least to some extent, by the wealth changes included in the inflation-adjusted measure of the budget balance, further discussion of the empirical results and forecasts is limited to those using this measure.

Chart 1

Real Trade-Weighted Value of U.S. Dollar and Real Long-Term Interest Rate Differential*



*U.S. real rate minus trade-weighted foreign real rate

The results thus far presented provide considerable support for the general equilibrium model and suggest that the omission of expected structural budget balances from the portfolio balance model is a serious error. They also indicate that the U.S. fiscal stimulus has had significant impact on the dollar and that its influence has worked through goods market pressures and interest rate differentials, but not through a risk premium.

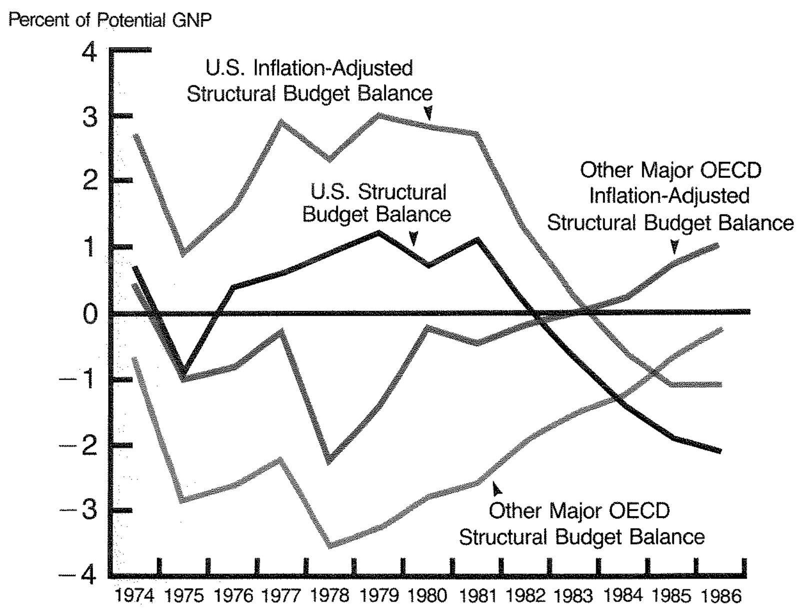
Chart 1 shows the movement in the real long-term interest differential between the U.S. and other major OECD countries implied by our estimated model from 1974 through the second quarter of 1985.[15] The real long-term interest rate differential in favor of the U.S. peaked in 1982 at around 4 percent and has since dropped sharply to around 1 percent in the second quarter of 1985. At the same time, the real value of the dollar continued to rise until early 1985. The shift of the U.S. budget into deficit and an accompanying movement of foreign budget balances towards surplus, shown in Chart 2, helps to explain the otherwise puzzling opposite movement between the real exchange rate and the real interest rate differential.

Estimates derived from the shorter sample period (1974:Q3–1981:Q4) shed further light on this explanation of the current strength of the dollar (Table 1, columns 1 and 2) and also provide an indication of the stability of the exchange rate model. These equations were used to make out-of-sample forecasts of the real value of the dollar through the second quarter of 1985. The results are shown in Chart 3. As expected, the exchange rate model containing only the real interest rate differential forecasts a steadily declining real value for the dollar after 1982. In contrast, the exchange rate model that also includes budget balances forecasts the extraordinary strength of the dollar out-of-sample rather well. Its forecast is almost exactly on track through the end of 1984, but misses the spike in the value of the dollar early in 1985.

A recent study by Meese and Rogoff (1983) has tested the out-of-sample forecasting properties of the most widely employed empirical exchange rate models. Their conclusion was that a random walk model, which uses the current exchange rate to predict future rates, generally had smaller out-of-sample forecasting error variance than any of the structural models

Chart 2

U.S. and Foreign Structural Budget Balances



examined. Interest rate differentials are an important element in a number of the models tested by Meese and Rogoff, but none of these models contains domestic or foreign budget balances.

In the post-1981 period, the random walk model has a smaller root mean square error (equal to 14.7) in forecasting the real value of the dollar than does the model containing only the real interest differential (equal to 18.1). This result comes as no surprise since it parallels the earlier findings of Meese and Rogoff. It is noteworthy, however, that the root mean square error of the out-of-sample forecast from the exchange rate model that includes U.S. and foreign budget balances as well as the real interest differential is much smaller (at 5.39) than that for either alternative forecast.

Out-of-sample fit is an important criterion to consider when evaluating any econometric model. This seems particularly true for exchange rate models, which appear to be subject to more than the usual degree of instability. Our out-of-sample forecasts suggest that a model stressing the importance of direct fiscal effects on the real value of the dollar, and not limited to indirect effects operating through interest rate differentials or risk premium determinants alone, gets a distinctly better rating than do most other models of exchange rate determination. The direct effect of fiscal policy on the longer run equilibrium value of the dollar is a largely neglected theoretical point, but one that appears to be highly important in practice.

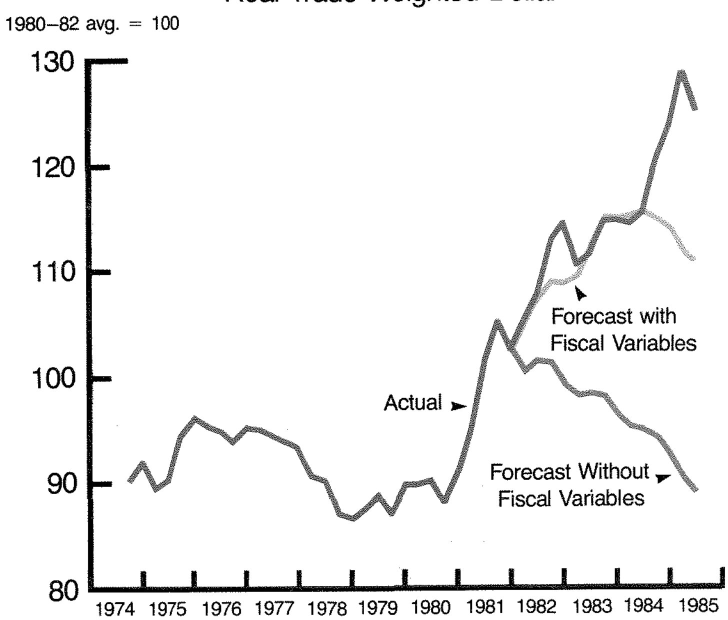
V. Conclusion

This paper has presented two alternative views on the way fiscal policy influences real exchange rates. Each leads to substantially different conclusions about the future course of the dollar in the foreign exchange market. The first view, based on a short-run, partial equilibrium portfolio balance model of exchange rate determination, predicts that the dollar will continue to depreciate either because of a declining real interest rate differential or because of investors' reluctance to continue to absorb U.S. dollar-denominated debt into their portfolios.

The second view, based on a longer run, general equilibrium model, predicts that the dollar is likely to remain strong by the standards of the late 1970s. In particular, this view suggests

Chart 3

Real Trade-Weighted Dollar



that as long as U.S. structural budget deficits remain large relative to those abroad, the real value of the dollar should remain substantially above its pre-1980 level.

Empirical estimates and out-of-sample forecasts based on the two alternative views largely support the "strong dollar" prediction of the general equilibrium model. Recent dollar declines appear mainly to be related to a narrowing real interest rate differential between the U.S. and abroad, and not to investors' reluctance to continue to absorb increasingly large amounts of U.S. debt into their portfolios. There is very little evidence that a significant exchange risk premium on dollar assets exists, or will soon develop.

In the absence of substantial further declines in U.S. real interest rates (or increases in foreign rates), our results suggest that aggregate demand pressures associated with U.S. budget deficits could well keep the dollar strong in the intermediate term. This conclusion contrasts with what appears to be the majority opinion of economists and forecasters. Although we accept the theoretical possibility of the consensus view that the dollar is likely to continue to fall in the near term, our evidence and that of other studies provides little empirical support for it.

A large number of analysts apparently hold to the opinion that the dollar must ultimately fall back to its pre-1980 level because a persistently high dollar value would continue to generate, in their view, unsustainably large U.S. current account deficits. This conclusion is based on the assumption that foreigners will not be willing to finance U.S. current account deficits at their present magnitude indefinitely. The rising stock of U.S. external debt, it is usually argued, will eventually generate large risk premia on U.S. assets. A rising risk premium, in turn, would cause U.S. interest rates to rise and the real value of the dollar to fall.

One recent projection (Krugman, 1985) indicates that if the dollar only gradually depreciated from its present high level, the U.S. foreign-debt-to-GNP ratio would continue to climb for the next 23 years, stabilizing at roughly 46 percent. If this were considered an unsustainably high ratio, then the implication is that the equilibrium value of the dollar must be considerably less than its present value.

Admittedly, our theoretical and empirical analysis does not purport to deal with a time horizon of a quarter of a century and a full long-run steady state stock equilibrium. But, as shown in Hutchison and Pigott (1985), our basic model's predictions appear to be reasonable even in the context of very long-run growth.[16] Moreover, we believe that time horizons of most market participants are relatively short. Our empirical estimates suggest horizons of roughly three to four years, and an informal survey of actual participants in the foreign exchange market suggests even shorter time horizons.

Even if market expectations are formed on a time horizon as long as a steady state analysis implicitly entails, there is some question as to whether a 46 percent foreign debt-to-GNP ratio for the U.S. *is* implausibly large. A number of countries less politically stable than the U.S. have external debts considerably larger than half of their GNP. And, given the status of the U.S. dollar as the premier investment, reserve and international transactions currency, world demand for U.S. assets is presumably (proportionally) larger than that for most other nations.

In conclusion, our results suggest that the real value of the dollar could well remain high by pre-1980 standards for the foreseeable future. Its strength is caused by aggregate demand pressures associated with greater fiscal expansion in the U.S. than abroad, combined with the general willingness of foreign lenders to finance U.S. current account deficits. Moreover, there is little evidence to suggest that the dollar's underlying strength is a speculative bubble that could easily be punctured by further official exchange market intervention. In early 1985, the dollar was indeed stronger than could be explained by fundamental factors. But by the third quarter a subsequent depreciation had moved the dollar back into line with the value predicted by our model.[17] At the present time, coordinated policies designed to reduce fiscal imbalances between the United States and abroad would likely be the most effective approach to bringing about a significant and longlasting decline in the real exchange value of the dollar in a non-inflationary environment.

FOOTNOTES

1. To show that (3) holds in real (price-adjusted) as well as nominal terms, we define the real exchange rate (q) and the future real exchange rate (q^e)expected to prevail n periods hence as:

$$s = q \frac{P^*}{P}$$

$$s^e = \frac{q^e P^*(1 + \dot{p}^*)^n}{P(1 + \dot{p})^n}$$

where

P = U.S. price level;
P^* = foreign price level;
$\dot{p}$ = expected U.S. inflation rate (annualized);
$\dot{p}^*$ = expected foreign inflation rate (annualized).

Taking logarithms of these two equations and substituting into equation 3, one gets:

$$\ln q = n[(i - \dot{p}) - (i^* - \dot{p}^*)] - n\phi^e + \ln q^e$$
$$\text{or } \ln q = n(r - r^*) - n\phi^e + \ln q^e$$

where $r = i - \dot{p}$

$r^* = i^* - \dot{p}^*$

2. This is a description of the adjustment to a fiscal stimulus in a world of flexible exchange rates and relatively unchanged price levels. The logic of the argument can be applied equally well to a world of fixed exchange rates and flexible price levels. As before, the fiscal stimulus is assumed to produce more of an increase in the demand for domestic goods than in the demand for foreign goods. In a world of fixed exchange rates, the result would be an increase in domestic prices relative to foreign prices. With a given nominal exchange rate, this relative change in prices implies an appreciation in the domestic real exchange rate.

3. This model is essentially a classical, or full employment, version of the Mundell-Fleming model of fiscal policy in a world of perfect capital mobility. See Mundell (1963) and Fleming (1962). However, the assumption about the relative impact of fiscal policy on spending in the two countries is also crucial to the outcome for the real exchange rate. If fiscal expansion increased the demand for foreign goods as much as the demand for home goods, there could be no impact on the exchange rate.

This part of the analysis is similar to the classical transfer problem. The literature on the classical transfer problem deals with the question of how a financial transfer of purchasing power between two countries—for example through gifts, reparations payments, or capital flows—effects a corresponding transfer of real resources. A question of particular importance in this literature is whether a change in the real exchange rate is required to effect the transfer. The answer turns on the income effects of the transfer on spending in the two countries. A famous early discussion of the transfer problem was between J.M. Keynes and Bertil Ohlin with regard to German reparations payments. See Ellis and Metzler (1950, pp. 161-179).

There is an important difference, however, between the effect of a fiscal expansion and the classical transfer analysis. This is that the former, the aggregate demand for goods worldwide is increased by a larger budget deficit (at the initial level of interest rates), while in the latter aggregate demand rises in the country receiving the transfer payment but falls in the paying country as the amount of the transfer payment is collected. In the classical case of no change in worldwide aggregate demand, the transfer of real resources can be carried out through a change in the trade balance without any alteration in the real exchange rate so long as the marginal propensities of the two countries to import sum to one. See Caves and Johnson (1968, pp. 115-171) and Mundell (1960). However, in the case of a fiscal expansion in only one of the countries, for there to be no change in the real exchange rate, it is necessary that fiscal expansion increase the demand for foreign goods as much as the demand for home goods.

4. This diagram comes from Dornbusch (1983) and Blanchard and Dornbusch (1984).

5. The difference between the classical transfer problem and the general equilibrium view of the effect of a budget deficit on the exchange rate can be illustrated with Diagram 2. The shift of G_0^{us} to G_1^{us} and G_0^{row} to G_1^{row} could just as well be produced by the effect on U.S. income of a transfer payment to the U.S. from the rest of the world. As the diagram is drawn, the propensity of the U.S. to spend the transfer on U.S. goods is greater than the propensity to import, so G^{us} shifts by more than G^{row}.

However, unlike the case of pure fiscal expansion in the U.S., in the classical transfer analysis the collection of the transfer abroad through taxation has income effects that reduce the demand for home goods and imports there. If the sum of the marginal propensities to import in the two countries were equal to one, the relatively large propensity of the U.S. to spend on domestic goods would be matched by an equally large propensity by the rest of the world to import. Adding the income effects for the rest of the world from the transfer to the diagram, the G_1^{us} schedule would therefore shift back exactly to G_0^{us} and, similarly, G_1^{row} would shift back to G_0^{row}. As a result, when the sum of the import propensities equals one, a pure transfer payment from the rest of the world to the U.S. would effect the required movement in real resources through a deterioration in the U.S. trade balance without any change in either the real exchange rate or the world interest rate.

6. This view has been widely expressed. Another example is Branson (1985). Moreover, in the analysis of Branson and others, the exchange rate will eventually depreciate below its initial level. This is because a zero balance current account is assumed to be a necessary equilibrium condition in the no-growth context of their models. Because the initial exchange rate appreciation causes a fall in net exports and an associated foreign capital inflow, the U.S. external debt rises. To generate a trade balance surplus that equals the net foreign debt interest payments (keeping a balanced current account), the exchange rate will fall below its initial level (see Rodriquez, 1979).

7. These are Japan, West Germany, France, the United Kingdom, Italy, and Canada.

8. The estimated equation for forecasting U.S. inflation over the maturity of the 6 month commercial paper rate is:

$$\dot{p}_{i+2} = -.141 + .463 \sum_{i=0}^{16} \dot{M1}_{-i} + .552 \sum_{i=0}^{10} \dot{p}_{-i}$$
$$(-.486) \quad (3.11) \qquad (4.24)$$
$$R^2 = .812 \quad S.E. = 1.26 \quad D.W. = 1.09$$

Equations based on monetary growth overpredict inflation in 1982 and 1983 by a substantial margin because of an unusual decline in M1 velocity. However, the demand for M1 was stable, so the decline in M1 velocity can be explained statistically by the decline in inflation and nominal interest rates that occurred in the period. If M1 growth is adjusted for this effect, it continues to predict the growth of nominal income and inflation reasonably well. Consequently, for this period, an adjusted M1 growth was used in the inflation forecasting equation instead of actual M1 growth. The adjustment factors that were used are described in Judd and McElhattan (1983). For an analysis of the effect of the decline in velocity on inflation and why it occurred, see Throop (1984a, b).

9. The source of the interest rate data is the Board of Governors' macrodata library. The data on consumer prices is from the International Monetary Fund, *International Financial Statistics*.

10. See Throop (1984,c).

11. The trade-weights used are those described in "Index of the Weighted-Average Value of the U.S. Dollar: Revision," *Federal Reserve Bulletin*. August 1978, p. 700.

12. If changes in real wealth affect consumption so that the inflation-adjusted measure of the budget balance is the correct one, then the theoretical model in Section II should be amended to include wealth as an argument in the absorption of goods and services in both countries.

Useful discussions of the concept of the inflation-adjusted budget balance include Eisner and Peiper (1984), Jump (1980), and Siegel (1979). The budgetary data used are the combined federal, state, and local balances compiled by the OECD. Trade-weights are clearly appropriate for combining the rest of the world's real interest rates. However, in the case of the structural budgets, the relative size of the country is a further consideration. The impact of a 1 percentage point change in a country's structural budget on the *bilateral* real exchange rate with the U.S. should be greater the larger is the size of that country's economy. Given the influence of relative GNP on the bilateral real rate, the impact on the real trade-weighted value of the dollar then depends upon the trade-weight of that country. Therefore, the weight for the foreign budget balances that we used is the trade-weight times the relative GNP-weight. Since GNP-weights and trade-weights are highly correlated, this weighting scheme is not, in fact, very different from pure trade weights.

Since the relative effects of B and B* on the real exchange rate depends upon the relative size of the U.S. versus the rest of the world, there is no reason in principle why the coefficients on the two budget balances should be constrained to be of equal absolute value, as is the case with U.S. and foreign interest rates.

13. This point is rigorously demonstrated in Frankel (1979).

14. D_s is calculated as U.S. federal government debt less liabilities to foreign official institutions and the Federal Reserve. W_w equals D_s plus central government debt net of central bank holdings in the six foreign countries. ΣCA is the value of U.S. net external assets in 1970 plus the U.S. current account surplus cumulated quarterly from 1971:Q1 on. The source of data for central government debt and the U.S. current account is the International Monetary Fund, *International Financial Statistics.* U.S. liabilities to official institutions is taken from U.S. Treasury Department, *Treasury Bulletin*. Since the supply of U.S. debt is measured net of U.S. liabilities to official institutions, the cumulative current account is also measured net of changes in these liabilities.

The domestic (D_d) and rest of world (D_d^*) demand functions for U.S. government debt may be expressed as proportions of total government bond holdings (both foreign and domestic), W and W*, of residents in each country. (The proportions of this wealth invested in the rest of the world's government debt equal one minus the percentages invested in U.S. debt.)

$$D_d = (b_d + b_0\phi^e)W$$
$$D_d^* = (b_d^* + b_0\phi^e)W^*$$

This formulation assumes that domestic and foreign demand for U.S. government bonds differ only by a constant term, which is higher in the U.S. because domestic investors prefer the home country habitat. Setting the supply of U.S. government debt, D_s, equal to the total demand, $D_d + D_d^*$, we have:

$$D_s = (b_d + b_0\phi^e)W + (b_d^* + b_0\phi^e)W^*$$

Letting $W + W^* = W_w$,

$$D_s = b_dW + b_d^* (W_w - W) + b_0\phi^eW_w$$

Then solving for ϕ^e,

$$\phi^e = \frac{D_s}{b_0W_w} - \frac{b_d - b_d^*}{b_0}\frac{W}{W_w} - \frac{b_d^*}{b_0}$$

Thus, the risk premium is a function of the ratio of the supply of U.S. government debt, D_s, to the total supply of government debt (both foreign and domestic), W_w, and also the ratio to total U.S. holdings of government bonds (both foreign and domestic), W, to total government debt. We measure W by adding to total U.S. government debt an amount that is some fraction of the cumulative current account surplus since only a portion of net private investment abroad goes into government bonds. This gives the values of ϕ^e to be substituted into equation 8 for the real exchange rate.

$$\phi^e = \frac{D_s}{b_0W_w} - \left(\frac{b_d - b_d^*}{b_0}\right)\left(\frac{D_s + \alpha\sum CA}{W_w}\right) - \frac{b_d^*}{b_0}$$

$$\text{or } \phi^e = \frac{1 - b_d + b_d^*}{b_0}\frac{D_s}{W_w} - \alpha\frac{b_d - b_a^*}{b_0}\frac{\sum CA}{W_w} - \frac{b_d^*}{b_0}$$

15. Since the estimated coefficient on each of the lagged differentials in short rates equals n times the weights in the distributed lag of an ordinary term structure relationship, and the sum of the estimated coefficients should be approximately equal to n, the original weights in the term structure can be obtained by dividing each estimated coefficient on the lagged differential in short rates by n. The

synthetic real long-term interest differential is then obtained by applying these derived weights to the current and past differentials in real short-term rates.

16. Hutchison and Pigott show that a permanent real exchange rate appreciation following a fiscal stimulus is likely under a wide range of plausible conditions. These conditions include a low risk premium and both modest output responses and small world interest rate increases in response to the fiscal stimulus.

17. When equation 2 in Table 1 is estimated through 1985:Q2, its predicted value for 1985:Q3 is almost exactly equal to the actual value of the real exchange rate.

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